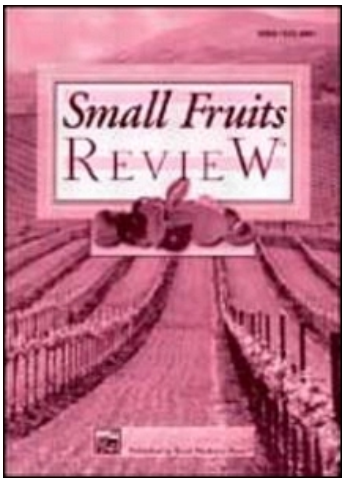


Small Fruits Review
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t904096214

The Effects of Chill Hour Accumulation on Hydrogen Cyanamide Efficacy in Rabbiteye and Southern Highbush Blueberry Cultivars

Stephen J. Stringer [a]; Donna A. Marshall [a]; Blair J. Sampson [a]; James M. Spiers [a]
[a] Department of Agriculture-Agricultural Research Service, Poplarville, MS, USA

Online Publication Date: 27 July 2004

To cite this Article Stringer, Stephen J., Marshall, Donna A., Sampson, Blair J. and Spiers, James M.(2004)'The Effects of Chill Hour Accumulation on Hydrogen Cyanamide Efficacy in Rabbiteye and Southern Highbush Blueberry Cultivars',Small Fruits Review,3:3,339 — 347

To link to this Article: DOI: 10.1300/J301v03n03_11

URL: http://dx.doi.org/10.1300/J301v03n03_11

The Effects of Chill Hour Accumulation on Hydrogen Cyanamide Efficacy in Rabbiteye and Southern Highbush Blueberry Cultivars

Stephen J. Stringer
Donna A. Marshall
Blair J. Sampson
James M. Spiers

SUMMARY. A controlled environment study was conducted to evaluate the effects of chill hour accumulation on the time of application and the resulting efficacy of the plant growth regulator, hydrogen cyanamide (H_2CN_2) in both rabbiteye (*Vaccinium asheii* Reade) and southern highbush (*V. corymbosum*) blueberry cultivars. Application of H_2CN_2 at the interval in which accruement of 75% of the individual chill-hour requirements of 'Bladen', 'Jubilee', 'Premier', and Tifblue' blueberry cultivars resulted in greater vegetative bud break than the 50% chill-hour application timing, or than their untreated checks. The 75% timing also resulted in a significant increase in the terminal growth of stems in

Stephen J. Stringer is Research Geneticist, Donna A. Marshall is Horticulturist, Blair J. Sampson is Research Entomologist, and James M. Spiers is Research Horticulturalist; all with the Department of Agriculture-Agricultural Research Service, Small Fruit Research Station, P.O. Box 287, Poplarville, MS 39470.

Address correspondence to: Stephen J. Stringer (E-mail address: sjstringer@ars.usda.gov).

[Haworth co-indexing entry note]: "The Effects of Chill Hour Accumulation on Hydrogen Cyanamide Efficacy in Rabbiteye and Southern Highbush Blueberry Cultivars." Stringer, Stephen J. et al. Co-published simultaneously in *Small Fruits Review* (Food Products Press, an imprint of The Haworth Press, Inc.) Vol. 3, No. 3/4, 2004, pp. 339-347; and: *Proceedings of the Ninth North American Blueberry Research and Extension Workers Conference* (ed: Charles F. Forney, and Leonard J. Eaton) Food Products Press, an imprint of The Haworth Press, Inc., 2004, pp. 339-347. Single or multiple copies of this article are available for a fee from The Haworth Document Delivery Service [1-800-HAWORTH, 9:00 a.m. - 5:00 p.m. (EST). E-mail address: docdelivery@haworthpress.com].

http://www.haworthpress.com/web/SFR
Digital Object Identifer: 10.1300/J301v03n03_11

'Bladen' and 'Premier'. Consideration of a blueberry cultivar's exposure to chill-hours in application timing decisions should provide a greater degree of precision in optimizing vegetative bud break with H_2CN_2. *[Article copies available for a fee from The Haworth Document Delivery Service: 1-800-HAWORTH. E-mail address: <docdelivery@haworthpress.com> Website: <http://www.HaworthPress.com>]*

KEYWORDS. Chill hours, dormancy, Dormex®, hydrogen cyanamide

INTRODUCTION

Deciduous fruit crops including blueberries annually undergo the physiological phase of development known as dormancy. The release of dormancy and subsequent development of floral and vegetative buds requires a period of exposure to winter chilling temperatures followed by a subsequent rise in temperatures in the spring (Coville, 1921; Fuchigami et al., 1982; NeSmith and Bridges, 1992; Suare, 1985). The amount of chilling (hours of exposure to temperatures below 7.2°C) required to break dormancy and induce floral and vegetative bud break varies among blueberry cultivars (Austin and Bondari, 1987; Darrow, 1942). Both rabbiteye (*Vaccinium ashei* Reade) and southern highbush (*Vaccinium corymbosum* L.) blueberries are grown in the Southeastern US and have chilling requirements ranging from 200 to 650 h. Mild winters occur frequently in this region and often result in abnormal floral and vegetative bud development in some blueberry cultivars (Lyrene and Williamson, 1997; NeSmith and Bridges, 1992). The adverse effects of delayed spring leafing in blueberries include reductions in fruit set and quality, and delays in maturity (Williamson and Lyrene, 1995). Stresses associated with insufficient leaf canopy may also result in early growth cessation, inhibiting the development of shoots, and floral and leaf buds necessary for the subsequent year's crop (Erez, 1987). Utilization of growth regulating compounds provides a mechanism for circumventing effects of insufficient chilling following mild winters by breaking leaf bud dormancy and promoting earlier spring leaf development. This relatively new cultural practice has importance as a management tool for Southern blueberry growers who previously without recourse faced risks to crop production in winters of insufficient chilling.

Dormex® (SKW, Trostberg, Germany; 49% hydrogen cyanamide, H_2CN_2), has been demonstrated to, in effect, substitute for inadequate

chilling and promote vegetative bud break and advanced leaf development in numerous deciduous fruit crops (Dokoozlian and Williams, 1995; Erez, 1987; Shulman et al., 1986; Siller-Cepeda et al., 1992). When applied properly to blueberries, its utilization has been demonstrated to advance vegetative bud break, increase leaf : fruit ratios, and hasten fruit maturity (Williamson et al., 2002). However, H_2CN_2 is phytotoxic to flower buds in more advanced stages of development, and in some fruit crops its use is actually recommended as a crop thinning agent (Falhi et al., 1998). Thus, the proper timing of H_2CN_2 applications in blueberries is critical in optimizing its efficacy for promoting leaf development while concurrently minimizing injury to those developing floral buds desired for fruit production (NeSmith, 1998). Current application timing recommendations from Florida and Georgia suggest that the material should be applied during the dormant season after "significant" chilling has occurred and before a significant number of flower buds have reached stage 3 (Spiers, 1978) of development. Although H_2CN_2 usage following these recommendations successfully improves spring leafing, the effects of chill hour accumulation on H_2CN_2 efficacy are not completely understood. Thus, the objectives of this research were to evaluate the effects of utilizing values for chill hour accumulation on H_2CN_2 efficacy, and assess its effects on crop initiation of rabbiteye and southern highbush blueberry cultivars.

MATERIALS AND METHODS

The experiment was conducted under greenhouse conditions in Poplarville, MS during 2001 and 2002. One-year-old potted 'Bladen' and 'Jubilee' southern highbush and 'Premier' and 'Tifblue' rabbiteye blueberries were used for this study. These blueberry cultivars are known to have chill hour accumulation (CHA) requirements of approximately 600, 500, 450, and 600 h below 7.2°C, respectively. Forty plants of each cultivar were placed in a cold room and sixteen of each were differentially removed after exposure to chilling of 50%, 75%, and 100% of their respective chill hour requirements. At each removal period, a solution of either 0 or 1.0% H_2CN_2 and 0.25% Surfaid, a non-ionic surfactant, was applied to point of drip to the entire canopy of eight plants per cultivar utilizing a knapsack sprayer. Plants allowed to accumulate 100% of their chill hour values were not treated with H_2CN_2 but instead

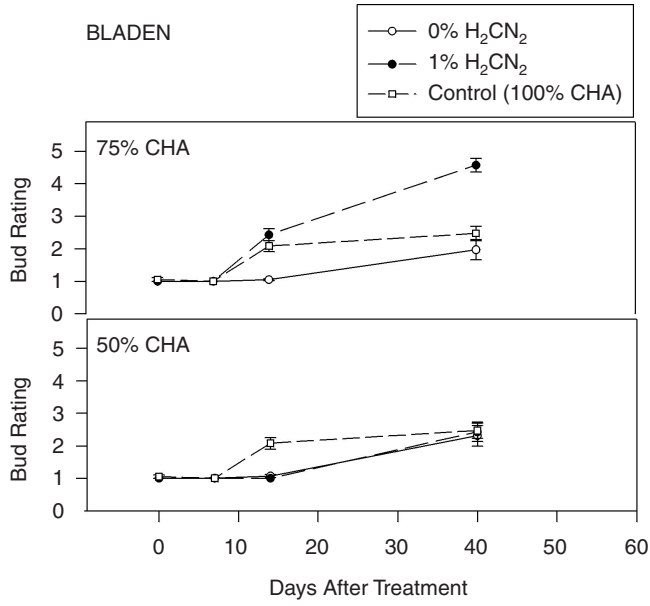
were used only as controls for comparative purposes. Treatments were arranged in a split-plot design with cultivar as the main effect and chill hour accumulation at time of application as sub-effects. Thus, each of eight plants represented a replication for each cultivar/timing/treatment combination. The developmental stages of vegetative and flower buds at the time of application were rated 1.0 (no visible bud swelling) and 2.0 (visible swelling of buds, scales starting to separate, flowers still completely in scales), respectively. To further promote bud break, following H_2CN_2 applications, plants were moved to, and grown under greenhouse conditions in which temperatures ranged from 20 to 25°C.

Ten stems per plant were randomly selected and tagged for evaluation. All vegetative buds on each stem were rated for stage of physiological development (NeSmith et al., 1998) every 7 to 10 d until 56 d after treatment. Flower buds were also assessed for evidence of mortality. At 56 d after treatment, the terminal growth of 10 stems per plant was measured. No fruit or yield data were included in the evaluations since natural pollination did not occur in the greenhouse environment. Data were subjected to mean and standard error calculations or ANOVA procedures (SAS Institute Inc., Cary, NC).

RESULTS AND DISCUSSION

No injury to flower buds was detected in any cultivar at either H_2CN_2 application timing (data not shown). Results of observations on vegetative bud development for the respective blueberry cultivars are presented in Figures 1-4. At each application timing, the 1.0% H_2CN_2 treatment resulted in increased rate of vegetative bud development in each of the four blueberry cultivars when compared to 0% H_2CN_2. Mean bud stage ratings observed on the last evaluation dates indicated that when H_2CN_2 was applied at the point at which cultivars had accumulated 50% of their chill hour requirement the vegetative bud ratings of ‘Bladen’, ‘Jubilee’, ‘Premier’, and ‘Tifblue’ advanced by 0.2, 0.4, 0.5, and 0.7 stages, respectively. H_2CN_2 applications made when these cultivars had accrued 75% of their chill hour requirements resulted in physiological development rating increases of 0.9, 1.0, 1.0, and 1.2, respectively. Comparing the 50% CHA, 1.0% H_2CN_2 application to the control (100% CHA, 0% H_2CN_2) at these evaluation dates, bud development ratings of the respective cultivars differed by −0.1, 0.4, 0.3, and

FIGURE 1. Effect of chill hour accumulation on efficacy of H_2CN_2 in vegetative budbreak and development in 'Bladen' southern highbush blueberry. Within the individual 50%, 75%, and 100% CHA (chill hours accumulated) figures, control = untreated.



0.3 stages. At 75% CHA + H_2CN_2, advances in bud development were substantially greater with rating increases of 1.9, 2.2, 1.5, and 1.0, respectively, over that of the control. Results of this study demonstrated that 1.0% H_2CN_2 applied to blueberry cultivars having artificially accrued 75% of their chill hour requirements, advanced vegetative bud development to a greater extent than applications at 50% CHA. This same treatment generated even greater vegetative bud development than that observed on cultivars having accrued 100% of their chill requirement, but lacking a supplemental H_2CN_2 application.

Results of evaluations on the effects of CHA at time of H_2CN_2 application on terminal growth of blueberry stems are presented in Table 1. At the 50% CHA application timing the control resulted in significantly greater terminal stem growth than either 0% or 1.0% H_2CN_2 in 'Bladen', 'Jubilee', and 'Premier'. Terminal growth resulting from 1.0% H_2CN_2 application at 50% CHA did not differ significantly from that from that of 0% H_2CN_2 in any cultivar. At 75% CHA, terminal stem growth of

FIGURE 2. Effect of chill hour accumulation on efficacy of H_2CN_2 in vegetative budbreak and development in 'Jubilee' southern highbush blueberry. Within the individual 50%, 75%, and 100% CHA (chill hours accumulated) figures, control = untreated.

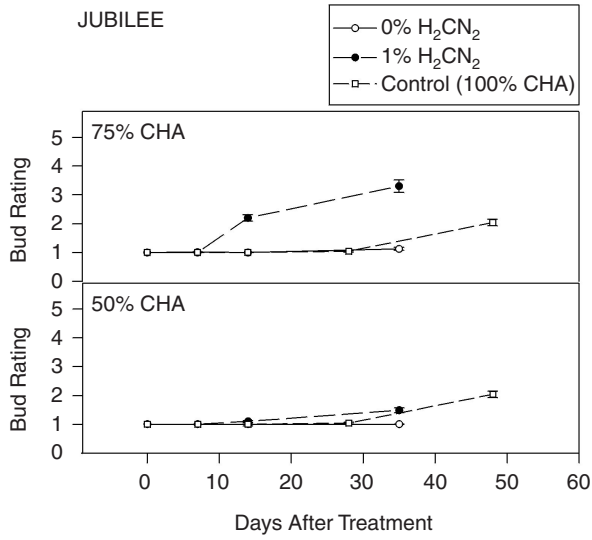


FIGURE 3. Effect of chill hour accumulation on efficacy of H_2CN_2 in vegetative budbreak and development in 'Premier' rabbiteye blueberry. Within the individual 50%, 75%, and 100% CHA (chill hours accumulated) figures, control = untreated.

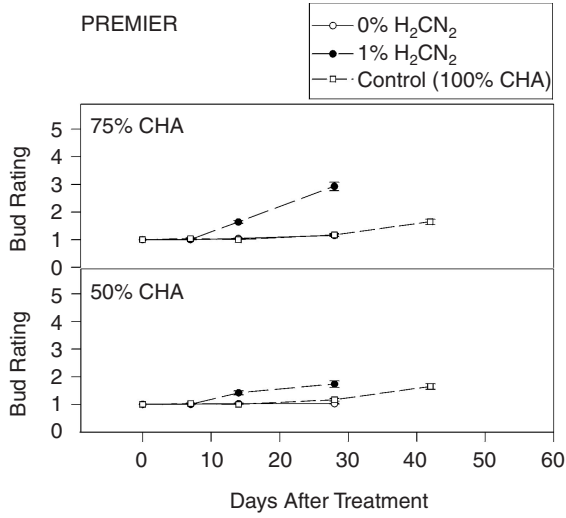
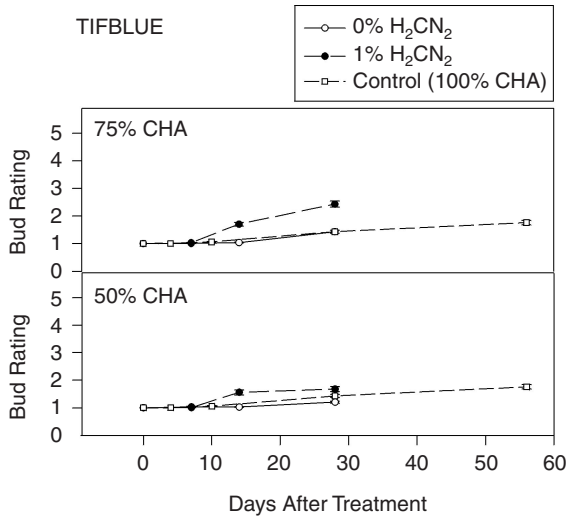


FIGURE 4. Effect of chill hour accumulation on efficacy of H_2CN_2 in vegetative budbreak and development in 'Tifblue' rabbiteye blueberry. Within the individual 50%, 75%, and 100% CHA (chill hours accumulated) figures, control = untreated.



both 'Bladen' and 'Premier' resulting from 1.0% H_2CN_2 was significantly greater than that resulting from 0% H_2CN_2, and that of 'Bladen' was also significantly greater than the control. Terminal growth on stems of 'Tifblue' was not affected by chill hour accumulation at the time of H_2CN_2 application.

CONCLUSIONS AND GROWER BENEFITS

The effects of chill hour accumulation on the efficacy of H_2CN_2 in blueberry cultivars have not been completely elucidated. This study demonstrates that the consideration of the degree of chilling a blueberry cultivar has accrued in application timing decisions should optimize the efficacy of H_2CN_2 and increase vegetative bud-break and subsequent bud development. Since the quality of artificial chilling differs from actual field conditions, field studies will be conducted to assess the effects of natural chill hour accumulation on the efficacy of H_2CN_2 in the induction of bud break in blueberry cultivars.

TABLE 1. The effect of CHA and H_2CN_2 on terminal growth of stems of blueberry cultivars.

	Chill Hour Accumulation (%)	
	50	75
	----------Terminal growth (mm)----------	
Bladen		
1.0% H_2CN_2	4.8 b[z]	15.5 a
0.0% H_2CN_2	4.4 b	4.9 c
Control[y]	9.3 a	9.3 b
Jubilee		
1.0% H_2CN_2	1.5 b	14.4 a
0.0% H_2CN_2	0.7 b	7.1 a
Control	7.9 a	7.9 a
Premier		
1.0% H_2CN_2	4.0 b	22.7 a
0.0% H_2CN_2	0.3 b	6.8 b
Control	12.7 a	12.7 ab
Tifblue		
1.0% H_2CN_2	8.0 a	8.0 a
0.0% H_2CN_2	7.5 a	7.8 a
Control	8.6 a	8.7 a

[y]Means separation within cultivar and within columns, P < .05 level, N = 10 stems per cultivar.
[z]100% chilling used as control.

LITERATURE CITED

Austin, M.E. and K. Bondari. 1987. The effect of chilling temperature on flower bud expansion of rabbiteye blueberry. Sci. Hortic. 31:71-79.

Coville, F.V. 1921. The influence of cold stimulating the growth of plants. J. Agr. Res. 20:151-160.

Darrow, G.M. 1942. Rest requirements for blueberries. Proc. Amer. Soc. Hort. Sci. 41:189-194.

Dokoozlian, N.K. and L.E. Williams. 1995. Chilling exposure and hydrogen cyanamide interact in breaking dormancy in grape buds. HortScience 30:1244-1247.

Eck, P. 1988. Plant development. In: Blueberry science. Paul Eck (ed.). Rutgers Univ. Press, New Brunswick, NJ.

Erez, A. 1987. Chemical control of bud break. HortScience 22:1244-1247.

Fallahi, E., R.R. Lee, and G.A. Lee. 1998. Commercial-scale use of hydrogen cyanaide for apple and peach blossom thinning. HortTechnology 8:556-560.

Fuchigami, L.H., C.J. Weiser, K. Kobayashi, R. Timmis, and L.V. Gusta. 1982. A degree growth stage (°GS) model and cold acclimation in temperate woody plants,

pp. 93-116. In: P.H. Li, and A. Sakai (eds.). Plant cold hardiness and freezing stress, vol. 2, Academic Press, NY.

Lyrene, P.M. and J.G. Williamson. 1997. Highbush blueberry varieties for Florida. Proc. Fla. State Hort. Soc. 110:171-174.

NeSmith, D.S. 1998. The effect of timing of Dormex applications on blueberry leafing and flower mortality. HortScience 33:601.

NeSmith, D.S., G. Krewer, and J.G. Williamson. 1998. A leaf bud development scale for rabbiteye blueberry (*Vaccinium ashei*, Reade). HortScience 33:757.

NeSmith, D.S. and D.C. Bridges. 1992. Modeling chilling effects on cumulative flowering: A case study using 'Tifblue' rabbiteye blueberry. J. Amer. Soc. Hort. Sci. 117:698-702.

SAS Institute, 1989. SAS/STAT user's guide. 4th ed. Ver. 6. SAS Inst., Cary, NC.

Shulman, Y., G. Nair, and S. Lavee. 1986. Oxidative processes in doremancy and the use of hydrogen cyanamide in breaking bud dormancy. Acta Hort. 179:141-148.

Siller-Cepeda, J.H, L.H. Fuchigami, and T.H.H. Chen. 1992. Hydrogen cyanamide-induced bud break and phytotoxicity in 'Redhaven' peach buds. HortScience 27: 874-876.

Spiers, J.M. 1978. Effect of stage of bud development on cold injury in rabbiteye blueberry. J. Amer. Soc. Hort. Sci. 103:452-455.

Suare, M.C. 1985. Dormancy release in deciduous fruit trees. Hort. Rev. 7:239-300.

Williamson, J.G., G. Krewer, B.E. Maust, and P.E. Miller. 2002. Hydrogen cyanamide accelerates vegetative bud break and shortens fruit development period. HortScience 37:539-542.

Williamson, J.G., B.E. Maust, and D.S. NeSmith. 1998. Timing and concentration of hydrogen cyanamide affect blueberry bud development and flower mortality. HortScience 36:922-924.

Williamson, J.G. and P.M. Lyrene. 1995. Commercial blueberry production in Florida. Univ. Florida Coop. Ext. Serv. Bul. SP-0129, Gainsville, FL.

Williamson, J.G., G. Krewer, B.E. Maust, and P.E. Miller. 2002. Hydrogen cyanamide accelerates vegetative bud break and shortens fruit development period. HortScience 37:539-542.

Williamson, J.G., G. Krewer, B.E. Maust, and P.E. Miller. 2002. Hydrogen cyanamide accelerates vegetative bud break and shortens fruit development period. HortScience 37:539-542.